

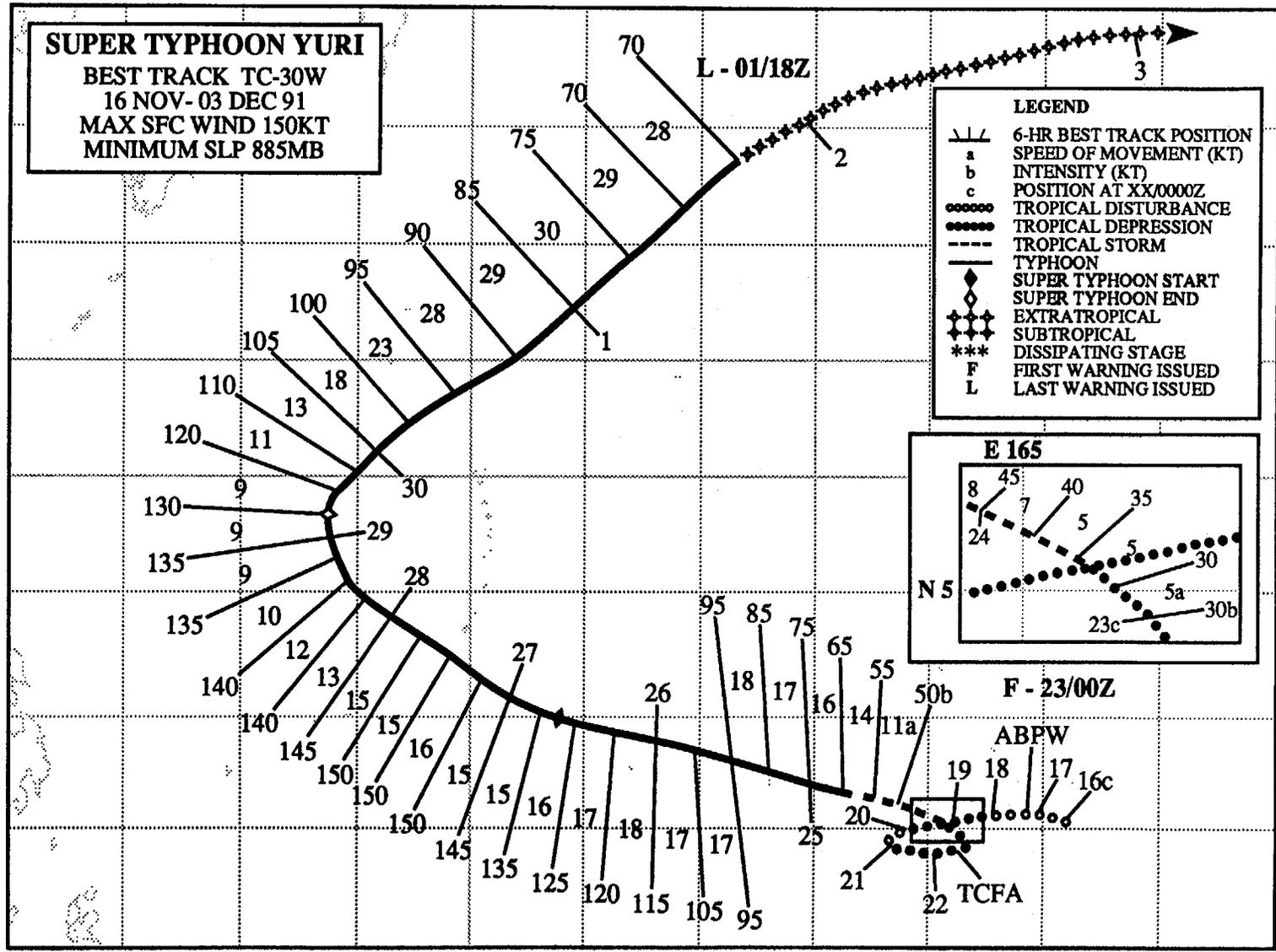
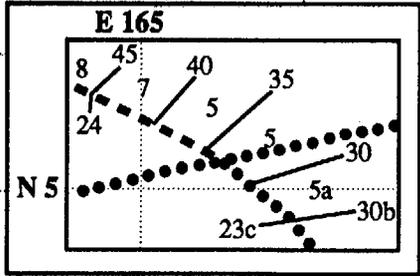
E 125 130 135 140 145 150 155 160 165 170 175 180

N 40

SUPER TYPHOON YURI
 BEST TRACK TC-30W
 16 NOV- 03 DEC 91
 MAX SFC WIND 150KT
 MINIMUM SLP 885MB

LEGEND

- /—/— 6-HR BEST TRACK POSITION
- a SPEED OF MOVEMENT (KT)
- b INTENSITY (KT)
- c POSITION AT XX/0000Z
- TROPICAL DISTURBANCE
- TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- ◆ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ✦ EXTRATROPICAL
- ✧ SUBTROPICAL
- *** DISSIPATING STAGE
- F FIRST WARNING ISSUED
- L LAST WARNING ISSUED



140

EQ

SUPER TYPHOON YURI (30W)

I. HIGHLIGHTS

Super Typhoon Yuri was the most intense tropical cyclone of the year, with maximum sustained winds estimated at 150 kt (77 m/sec) and an estimated minimum sea-level pressure of 885 mb. It also was the closest approach to Guam of a cyclone of this intensity since Super Typhoon Karen (1962). Yuri's normal (verses rapid) rate of intensification to a super typhoon was unusual. High water and massive waves caused extensive damage to coastal areas in the southeastern part of Guam.

II. TRACK AND INTENSITY

Low-level westerly winds along the equator extended eastward to the international date line in mid-November. On 16 November, a marked increase in deep convection occurred near 5°N between 160°E and 175°E, and the area was first mentioned on the Significant Tropical Weather Advisory at 170600Z. This tropical disturbance moved slowly westward at about 6°N until it executed a slow counterclockwise loop east of Kosrae in the eastern Caroline Islands between 19 and 23 November. During these five days, convective organization fluctuated about a slow trend toward improved organization. JTWC issued a Tropical Cyclone Formation Alert at 220900Z. The first warning on Tropical Depression 30W was issued at 230000Z, based on a further improvement in convective organization. Twelve hours later, the tropical cyclone was upgraded to a tropical storm when the satellite signature from the Dvorak Technique indicated maximum winds were 35 kt (18 m/sec). Yuri continued to intensify as it accelerated west-northwestward, and reached typhoon intensity 180 nm (335 km) east of Pohnpei at 241800Z. At this time Yuri was about 300 nm (555 km) in diameter, the size of an "average" typhoon. Pohnpei, (WMO 91348) reported a minimum sea-level pressure of 989 mb and a peak wind gust of 64 kt (33 m/sec) when the eye of the typhoon passed 45 nm (85 km) to the north at 250540Z.

On 26 November, as Yuri approached the western periphery of the subtropical ridge axis, it turned slightly toward the northwest and became a super typhoon at 261500Z. The rate of intensification during the 72-hour period from 240600Z to 270600Z was unusual. Unlike most super typhoons which experience an 18- to 30-hour period of rapid or explosive deepening, Yuri's intensity developed steadily at a rate of about 35 kt (18 m/sec) per day. Based on the satellite analyst's current intensity estimate, it reached a peak intensity of 150 kt (77 m/sec) at 270600Z. Yuri grew rapidly in size, reaching 600 nm (1110 km) in diameter, as it approached Guam.

Super Typhoon Yuri posed an extremely serious threat to Guam. Because of its close proximity to the island and a forward motion in excess of 15 kt (28 km/hr), a small change in direction could have rapidly changed the projected closest point of approach to the island resulting in a direct hit with short notice. Fortunately for the people of Guam, the center of the cyclone passed 55 nm (100 km) south of the southern tip of the island. Maximum sustained winds reported on Guam were 80 kt (42 m/sec) with gusts to 100 kt (51 m/sec) in Apra Harbor. The maximum sustained (over water) winds near southern Guam were estimated to be 100 kt (51 m/sec), gusting to 125 kt (64 m/sec).

After passing the Mariana Islands, the super typhoon (Figure 3-30-1) turned northward, and began to slowly weaken as it rounded the western portion of the subtropical ridge. By this time Yuri's size had grown to a massive diameter of 900 nm (1665 km). After its point of recurvature at 290600Z, Yuri was downgraded to a typhoon. North of 20°N latitude, the typhoon accelerated northeastward and gradually transitioned into an intense, late fall extratropical low pressure system. JTWC's final warning

was issued on 1 December at 1800Z when satellite imagery revealed a significant decrease in convection near the cyclone's center.

III. FORECAST PERFORMANCE

The sequence of JTWC track forecasts correctly predicted Super Typhoon Yuri would pass south of Guam and follow a typical late season recurvature track by turning northward between 135°E and 140°E (Figure 3-30-2). Early warnings on the tropical cyclone had difficulty predicting



Figure 3-30-1. A spectacular telephoto image from the NASA Space Shuttle Atlantis' mission STS-44 of Super Typhoon Yuri at 145 kt (75 m/sec). Note the cyclonically curved stratocumulus clouds in the high horizontal speed shear zone near the edge of the eye wall (280404Z November photograph courtesy of NASA, Lyndon B. Johnson Space Center, Houston, Texas).

translational motion, since the typhoon accelerated from 5 kt (9 km/hr) on the 23 November to 18 kt (33 km/hr) on 25 November. Although the system continued to accelerate west-northwestward near Pohnpei, JTWC forecast guidance and the warnings based on it, indicated the typhoon would slow as it neared the Marianas. Consequently, early in the week, residents on Guam expected Yuri would make its closest approach on Thanksgiving Day (28 November). Once the forward motion was established, JTWC track forecasts proved to be very accurate as the super typhoon approached Guam. Although JTWC predicted that Yuri would be near super typhoon intensity as it neared Guam, intensity forecasts were a problem. Super typhoon intensity was not expected to occur since the rapid or explosive deepening episode normally associated with super typhoons had not been observed. JTWC also had considerable problems predicting the growth in size of Yuri, as it expanded in size from 300 nm (555 km) to over 900 nm (1665 km) in a little over three days.

Ten hours before Yuri reached its closest point of approach to Guam, NOCC/JTWC recommended that Guam Civil Defense evacuate the southeast coast since inundation exceeding 20 feet (8 m) was expected.

While the forecast performance was only slightly better than average, the warning service provided by NOCC/JTWC was excellent. Yuri's potential to inch closer to Guam, its depiction as an "extremely dangerous storm," and its ability to produce very high waves were passed to residents in hourly updates to the media, convincing people in vulnerable areas to evacuate. This action and the populations appropriate response prevented the loss of lives.

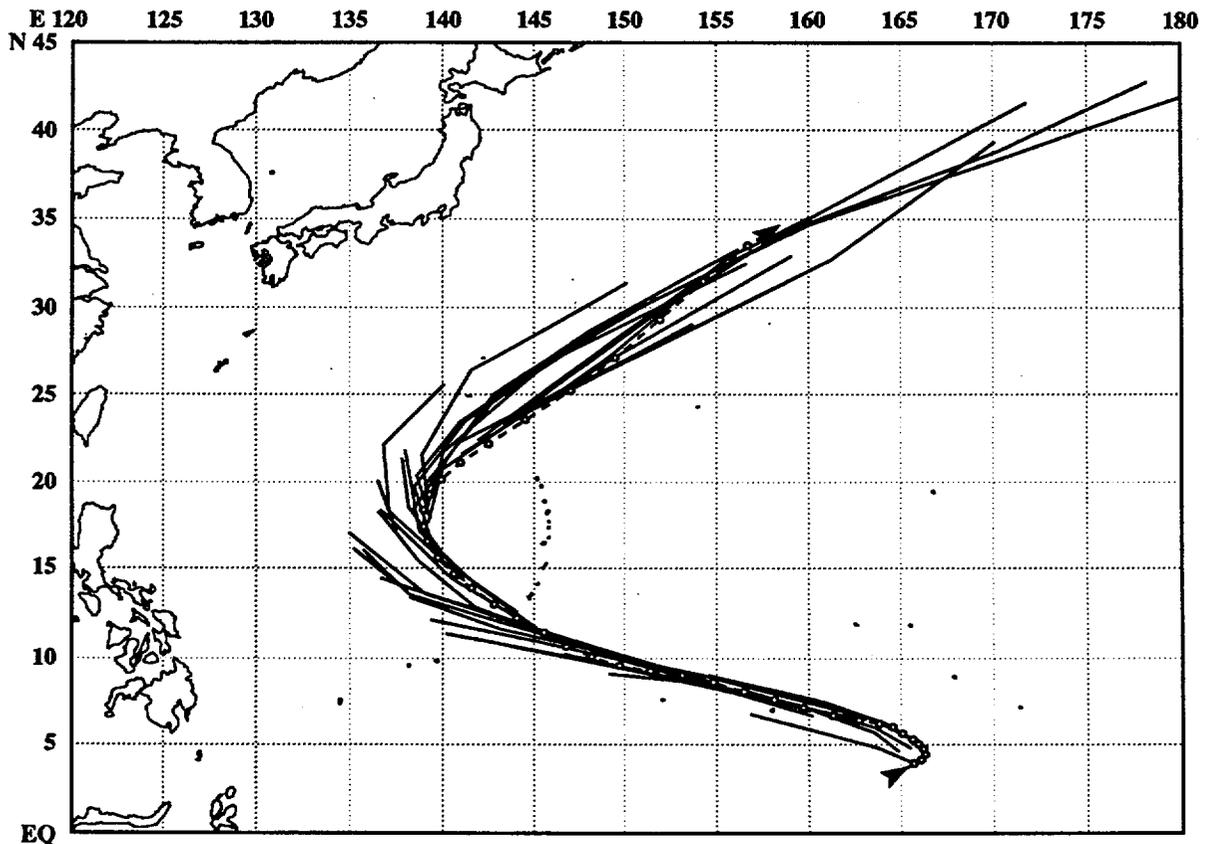


Figure 3-30-2. Summary of JTWC forecasts (solid line) superimposed on Yuri's final best track (dashed line).

IV. IMPACT

An estimated total of \$33 million in damage was attributed to Super Typhoon Yuri on Guam, primarily the result of flooding along the southeastern coast. By making its closest point of approach at high tide, the combined effects of a large translational speed, massive size, super typhoon intensity and the cyclone's center location south of Guam exposed the island to a prolonged period of northeasterly winds. This created ideal conditions for extreme surf on the eastern side of the island. Waves in excess of 30 ft (12 m) battered the southeastern coastline. Estimates of high water levels and wave run up at high energy areas with little or no protecting reef flats are shown in Figure 3-30-3. Some of these areas experienced inundation two to three times greater than with Typhoon Russ (1990), 11 months earlier.

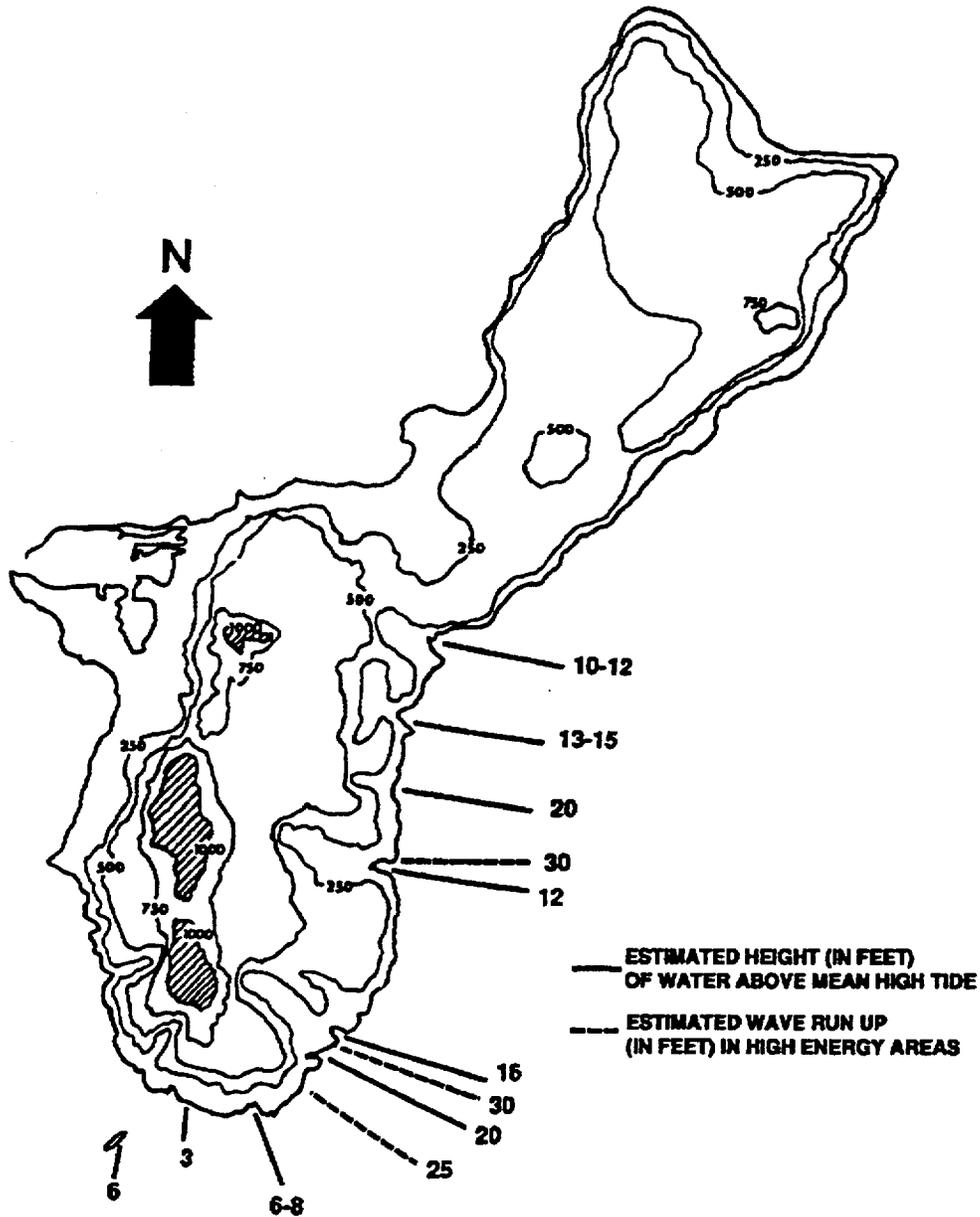


Figure 3-30-3. Estimated water heights above mean high tide and wave run up in the high energy areas of southeastern Guam. Estimated values (in feet) are based on observations taken immediately after tropical cyclone passage.

Yuri's disastrous combination of high water effects caused much greater inundation, reef damage and beach erosion to the island's low-lying beaches and bays along the southeast coastline. Sixty-two homes were totally destroyed; another 207 had major damage; and 348 sustained minor damage. Damage estimates included \$19.1 million to public facilities and infrastructure, \$10.8 million to commercial buildings and equipment, \$2.5 million to residential structures, and \$500,000 to agriculture (Figure 3-30-4). Guam residents were without power and water during the Thanksgiving holiday weekend.

Yuri caused an estimated \$3 million in damage on Pohnpei, including the loss of the island's only AM radio station tower. Officials on Rota placed damage estimates at \$2 million. There was no loss of life in the Marianas or Pohnpei as a result of the cyclone.



Figure 3-30-4. Yuri's high winds uprooted this large tree and parked it on a car. The more flexible, smaller coconut palms in the background survived (Photograph courtesy of Mrs. Patricia L. Hudson).